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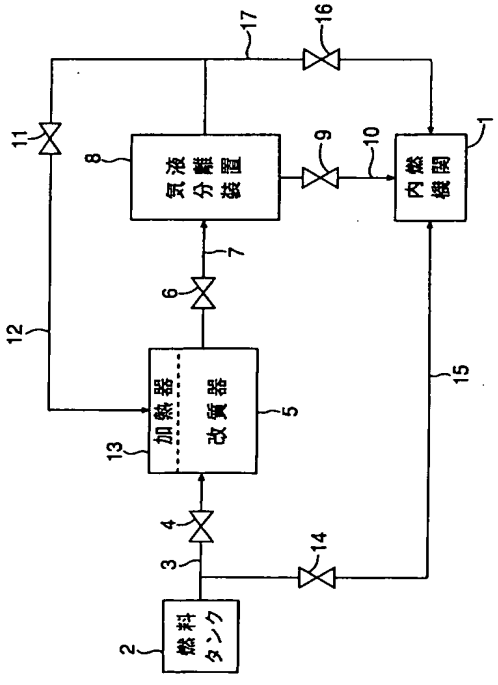
(54)【発明の名称】　内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両

(57)【要約】
【課題】　芳香族炭化水素に富む高オクタン価の改質液体燃料を得ることができるようにした，内燃機関を搭載した車両を提供する。
【解決手段】　内燃機関１を搭載した車両が，液体燃料の少なくとも一部を脱水素環化反応により改質して，芳香族炭化水素に富む高オクタン価の改質液体燃料および水素に富む改質ガス燃料を生成する改質器５と，改質液体燃料と改質ガス燃料を分離する気液分離装置８と，改質液体燃料の少なくとも一部を内燃機関１にそれの燃料として供給する装置とを備えている。



1

【特許請求の範囲】

【請求項１】　内燃機関（１）を搭載した車両に，液体燃料の少なくとも一部を脱水素環化反応により改質して，芳香族炭化水素に富む高オクタン価の改質液体燃料および水素に富む改質ガス燃料を生成する改質器（５）と，前記改質液体燃料と前記改質ガス燃料を分離する気液分離装置（８）と，前記改質液体燃料の少なくとも一部を前記内燃機関（１）にそれの燃料として供給する装置とを備えたことを特徴とする内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両。

【請求項２】　前記改質ガス燃料の少なくとも一部を前記改質器（５）のガス燃焼式加熱器（１３）に供給する装置を備えた，請求項１記載の内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両。

【請求項３】　脱水素環化反応に用いられる触媒が結晶性アルミノシリケートである，請求項１または２記載の内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両。

【請求項４】　前記結晶性アルミノシリケートがＭＦＩ構造を持つ，請求項３記載の内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両。

【請求項５】　前記結晶性アルミノシリケートが，ガリウム，亜鉛および白金から選ばれる少なくとも一種を含む，請求項４記載の内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は，内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両に関する。

【０００２】

【従来の技術】従来，この種の車両として燃料用改質器を備えたものが知られている（例えば特開昭５２－９８８１９号公報，特開２０００－２９１４９９号公報参照）。

【０００３】

【発明が解決しようとする課題】しかしながら従来の燃料用改質器によると，改質された燃料はガス状であるものがほとんどであり，改質後に液体として得られる高オクタン価成分は少ない。ガス燃料は同一発熱量の液体燃料と比較して体積が極めて大きいために，内燃機関への充填効率が低下し，内燃機関の出力を大きくすることが難しい。また，ガス燃料は一時的にも貯蔵しておくことが困難なため，例えば車両の加速時のように多量の燃料を必要とする場合に対応が困難である。

【０００４】一方，従来の改質器は，改質に必要な熱を排気ガスの余熱より得ているので，排気ガスの温度が内燃機関の運転状況によって大きく変化することから，改質反応が不安定になるという問題があった。

【０００５】

【課題を解決するための手段】本発明は，高オクタン価

2

成分量が多い改質液体燃料を得て，内燃機関のエネルギ効率を向上させ得るようにした前記車両を提供することを目的とする。

【０００６】前記目的を達成するため本発明によれば，内燃機関を搭載した車両に，液体燃料の少なくとも一部を脱水素環化反応により改質して，芳香族炭化水素に富む高オクタン価の改質液体燃料および水素に富む改質ガス燃料を生成する改質器と，前記改質液体燃料と前記改質ガス燃料を分離する気液分離装置と，前記改質液体燃料の少なくとも一部を前記内燃機関にそれの燃料として供給する装置とを備えた，内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両が提供される。

【０００７】前記脱水素環化反応によれば，オクタン価の低い炭化水素を含む液体燃料から，芳香族炭化水素に富む高オクタン価の改質液体燃料を得ることができ，これにより内燃機関のエネルギ効率を向上させることが可能である。

【０００８】本発明は前記改質反応を安定化し得るようにした前記車両を提供することを目的とする。

【０００９】前記目的を達成するため本発明によれば，前記改質ガス燃料の少なくとも一部を前記改質器のガス燃焼式加熱器に供給する装置を備えた，内燃機関を搭載し，且つ燃料の改質・供給機能を有する車両が提供される。

【００１０】前記芳香族炭化水素が生成する際に，オクタン化の低い炭化水素の脱水素反応により水素に富んだ改質ガス燃料が生成する。この改質ガス燃料を改質液体燃料から分離して，その少なくとも一部を改質器の加熱用ガス燃焼式加熱器に，その燃料として定常的に供給し得るので，改質器の改質反応を安定化させることが可能である。

【００１１】

【発明の実施の形態】図１に示す内燃機関１を搭載した車両の燃料供給システムにおいて，燃料タンク２が，開閉弁４を有する供給管３を介して改質器５の入口側に接続され，その改質器５の出口側は開閉弁６を有する供給管７を介して気液分離装置８の入口側に接続される。気液分離装置８の第１の出口側は開閉弁９を有する供給管１０を介して内燃機関１の燃料導入側に接続され，また第２の出口側は開閉弁１１を有する供給管１２を介して改質器５の加熱用ガス燃焼式加熱器１３に接続される。供給管３における，燃料タンク２および開閉弁４間と内燃機関１の燃料導入側とが開閉弁１４を有する供給管１５を介して接続される。また供給管１２における，気液分離装置８および開閉弁１１間と内燃機関１の燃料導入側とが開閉弁１６を有する供給管１７を介して接続される。

【００１２】燃料タンク２内には液体燃料が注入されている。改質器５は原料である液体燃料を脱水素環化反応により接触改質する機能を有するもので，液体燃料から

芳香族炭化水素に富む高オクタン価の改質液体燃料と水素に富む改質ガス燃料とを生成する。その改質ガス燃料には，水素の外にメタン，エタン，プロパン等のパラフィン系炭化水素ガスが含まれる。

【００１３】気液分離装置８は，芳香族炭化水素に富む高オクタン価の改質液体燃料と，水素に富む改質ガス燃料とを分離して，その改質液体燃料の少なくとも一部を内燃機関１に供給し，また改質ガス燃料の少なくとも一部を改質器５のガス燃焼式加熱器１３に供給する機能を有する。さらに気液分離装置８は改質ガス燃料の少なくとも一部を内燃機関１に供給する機能も有する。実施例では，気液分離装置８は気液分離機能と燃料供給機能とを有するが，燃料供給は別の装置により行うようにしてもよい。

【００１４】改質器５に脱水素環化反応を促進する触媒が充填される。脱水素環化反応用触媒としては，例えば

ゼオライトのような結晶性アルミノシリケート，特に，ＭＦＩ構造を持ったＺＳＭ－５ゼオライトが好適であり，好ましくは，ガリウム，亜鉛および白金から選ばれる少なくとも一種を含有することが望ましい。また脱水素環化反応の温度は４００～７００℃に設定される。

【００１５】表１はプロトン型ＺＳＭ－５（Ｈ－ＺＳＭ－５），ガリウム修飾ＺＳＭ－５（Ｇａ－ＺＳＭ－５）および亜鉛修飾ＺＳＭ－５（Ｚｎ－ＺＳＭ－５）をそれぞれ触媒とし，燃料としてｎ－ペンタンを用いて脱水素環化反応を行った改質結果を示す。ガリウムおよび亜鉛の量は触媒重量の２ｗｔ％とした。改質条件は重量空間速度（ＷＨＳＶ）２h^{-1}，改質温度５５０℃，改質圧０．１ＭＰａとした。

【００１６】

【表１】

触　媒	改質燃料の成分（ｗｔ％）		
	水　素	パラフィン系炭化水素ガス	芳香族炭化水素
Ｈ－ＺＳＭ－５	2.0	５４.９	４３.１
Ｇａ－ＺＳＭ－５	3.0	４６.４	５０.６
Ｚｎ－ＺＳＭ－５	3.6	４４.８	５１.６

【００１７】表１より，Ｈ－ＺＳＭ－５を触媒として用いると，脱水素環化反応が十分に進行することが明らかである。ガリウムまたは亜鉛で修飾した触媒を用いると，芳香族炭化水素と水素の収量が，Ｈ－ＺＳＭ－５を用いた場合よりも増加していることが判る。

【００１８】前記構造において，開閉弁４が開で，且つ開閉弁１４が閉の状態で，液体燃料が液体燃料タンク２から供給管３を通じて改質器５の入口に供給される。この場合，開閉弁１４を開くことにより，液体燃料を改質せずに内燃機関へ供給することも可能である。改質器５においては液体燃料の脱水素環化反応により芳香族炭化水素に富む高オクタン価の改質液体燃料および水素に富む改質ガス燃料よりなる改質燃料が生成される。改質燃料は改質器５の出口より開閉弁６が開の状態で供給管７を通じて気液分離装置８に供給される。気液分離装置８において，改質燃料は改質液体燃料と，改質ガス燃料とに分離され，改質液体燃料は開閉弁９が開の状態で供給管１０を通じて内燃機関１に供給される。一方，改質ガス燃料は開閉弁１１が開で，且つ開閉弁１６が閉の状態で供給管１２を通じて，改質器５の加熱用ガス燃焼式加熱器１３に供給される。この場合，改質ガス燃料の一部を，開閉弁１６が開の状態で供給管１７を通じて内燃機関１に供給することも可能である。また内燃機関１の排気ガスの熱を改質器５の加熱用熱源としてガス燃焼式加熱器１３と共に使用することも可能である。

【００１９】

【発明の効果】請求項１，３～５記載の発明によれば，前記のように構成することによって芳香族炭化水素に富む高オクタン価の液体燃料を得て，内燃機関のエネルギ効率を向上させ得るようにした車両を提供することができる。

【００２０】請求項２記載の発明によれば，改質器の改質反応を安定化し得るようにした車両を提供することができる。

【図面の簡単な説明】

【図１】燃料供給システムの系統図である。

【符号の説明】

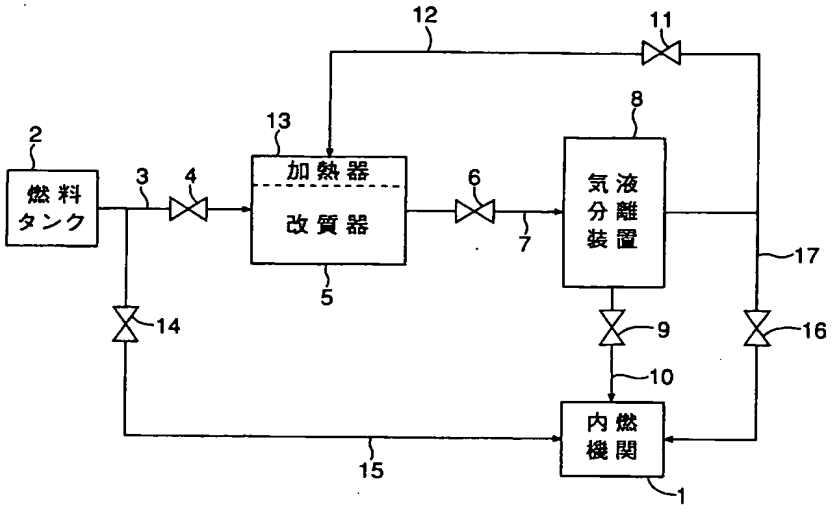
１……内燃機関

５……改質器

８……気液分離装置

１３……加熱器

【図１】



フロントページの続き

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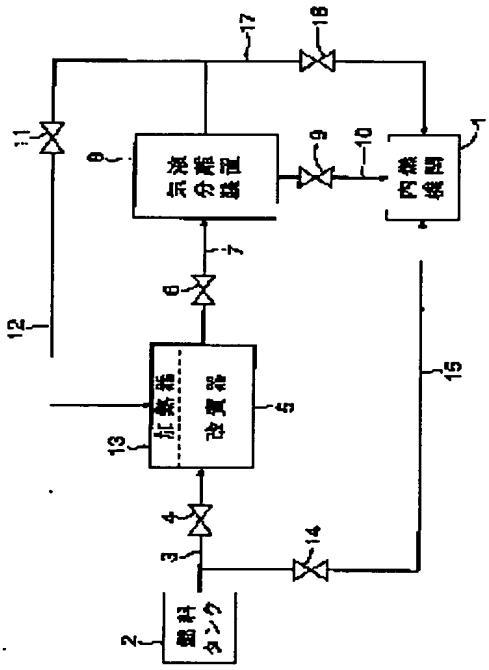
(54) VEHICLE MOUNTING INTERNAL COMBUSTION ENGINE AND HAVING FUEL REFORMING/SUPPLYING FUNCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a vehicle mounting an internal combustion engine that can obtain reformed high-octane liquid fuel being rich in aromatic hydrocarbon.

SOLUTION: This vehicle mounting an internal combustion engine 1 includes a reformer 5 and a gas-liquid separating device 8. The reformer 5 reforms at least part of liquid fuel by dehydrocyclization reaction and generates reformed high-octane liquid fuel being rich in aromatic hydrocarbon and reformed gas fuel being rich in hydrogen. The gas-liquid separating device 8 separates the reformed liquid fuel and the reformed gas fuel. The vehicle also includes a device to supply at least part of the reformed liquid fuel to the internal combustion engine 1 as its fuel.



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CLAIMS

[Claim(s)]
[Claim 1] On the car carrying an internal combustion engine (1), some liquid fuel [at least] is reformed by the cyclodehydrogenation reaction. The reforming machine which generates the reformed gas fuel which is rich in the reforming liquid fuel and hydrogen of a high octane value which are rich in aromatic hydrocarbon (5), The car which carries the internal combustion engine characterized by having the vapor-liquid-separation equipment (8) which separates said reforming liquid fuel and said reformed gas fuel, and equipment which supplies said some of reforming liquid fuel [at least] to said internal combustion engine (1) as a fuel of that, and has reforming and the supply function of a fuel.
[Claim 2] The car equipped with the equipment which supplies said some of reformed gas fuels [at least] to the gas combustion equation heater (13) of said reforming machine (5) which carries an internal combustion engine according to claim 1, and has reforming and the supply function of a fuel.
[Claim 3] The car whose catalyst used for a cyclodehydrogenation reaction is crystalline aluminosilicate and which carries an internal combustion engine according to claim 1 or 2, and has reforming and the supply function of a fuel.
[Claim 4] The car in which said crystalline aluminosilicate has MFI structure and which carries an internal combustion engine according to claim 3, and has reforming and the supply function of a fuel.
[Claim 5] The car which carries the internal combustion engine according to claim 4 as which said crystalline aluminosilicate is chosen from a gallium, zinc, and platinum, and which contains a kind at least, and has reforming and the supply function of a fuel.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the car which carries an internal combustion engine and has reforming and the supply function of a fuel.
[0002]
[Description of the Prior Art] Conventionally, what was equipped with the reforming machine for fuels as this kind of a car is known (for example, refer to JP,52-98819,A and JP,2000-291499,A).
[0003]
[Problem(s) to be Solved by the Invention] However, according to the conventional reforming machine for fuels, that whose fuel by which reforming was carried out is a gas is most, and the high octane value component obtained as a liquid after reforming has them. [few] Since the volume is very large as compared with the liquid fuel of the same calorific value, it is difficult for fuel gas for the charging efficiency to an internal combustion engine to fall, and to enlarge an internal combustion engine's output. Moreover, fuel gas is difficult to correspond, since it is difficult to store also temporarily, for example, when it needs a lot of fuels like [at the time of acceleration of a car].
[0004] On the other hand, since heat required for reforming had been obtained from the remaining heat of exhaust gas and the temperature of exhaust gas changed with an internal combustion engine's operation situations a lot, the conventional reforming machine had the problem that a reforming reaction became unstable.
[0005]
[Means for Solving the Problem] This invention obtains reforming liquid fuel with many amounts of high octane value components, and aims at offering said car which might make it have made it an internal combustion engine's energy efficiency improve.
[0006] In order to attain said purpose, according to this invention, some liquid fuel [at least] is reformed by the cyclodehydrogenation reaction on the car carrying an internal combustion engine. The reforming machine which generates the reformed gas fuel which is rich in the reforming liquid fuel and hydrogen of a high octane value which are rich in aromatic hydrocarbon, The car equipped with the vapor-liquid-separation equipment which separates said reforming liquid fuel and said reformed gas fuel, and the equipment which supplies said some of reforming liquid fuel [at least] to said internal combustion engine as a fuel of that which carries an internal combustion engine and has reforming and the supply function of a fuel is offered.
[0007] According to said cyclodehydrogenation reaction, the reforming liquid fuel of a high octane value which is rich in aromatic hydrocarbon can be obtained from the liquid fuel containing a hydrocarbon with a low octane value, and it is possible to raise an internal combustion engine's energy efficiency by this.
[0008] This invention aims at offering said car which enabled it to stabilize said reforming reaction.
[0009] In order to attain said purpose, according to this invention, the car equipped with the equipment which supplies said some of reformed gas fuels [at least] to the gas combustion equation heater of said reforming machine which carries an internal combustion engine and has reforming and the supply function of a fuel is offered.
[0010] In case said aromatic hydrocarbon generates, the reformed gas fuel which was rich in hydrogen with the dehydrogenation of the low hydrocarbon of octane-izing generates. Since this reformed gas fuel is separated from reforming liquid fuel and that part [at least] can be regularly supplied to the heating gas combustion equation heater of a reforming machine as that fuel, it is possible to stabilize the reforming reaction of a reforming machine.

[0011]
[Embodiment of the Invention] In the fuel distribution system of the car carrying the internal combustion engine 1 which shows drawing 1 , a fuel tank 2 is connected to the entrance side of the reforming machine 5 through the supply pipe 3 which has the closing motion valve 4, and the outlet side of the reforming machine 5 is connected to the entrance side of vapor-liquid-separation equipment 8 through the supply pipe 7 which has the closing motion valve 6. The 1st outlet side of vapor-liquid-separation equipment 8 is connected to an internal combustion engine's 1 fuel installation side through the supply pipe 10 which has the closing motion valve 9, and the 2nd outlet side is connected to the heating gas combustion equation heater 13 of the reforming machine 5 through the supply pipe 12 which has the closing motion valve 11. An internal combustion engine's 1 fuel installation side is connected through the supply pipe 15 which has the closing motion valve 14 between the fuel tanks 2 and the closing motion valves 4 in a supply pipe 3. Moreover, an internal combustion engine's 1 fuel installation side is connected through the supply pipe 17 which has the closing motion valve 16 between the vapor-liquid-separation equipment 8 in a supply pipe 12, and the closing motion valve 11.
[0012] Liquid fuel is poured in into the fuel tank 2. The reforming machine 5 has the function which carries out catalytic reforming of the liquid fuel which is a raw material by the cyclodehydrogenation reaction, and generates the reforming liquid fuel of a high octane value with which it is rich in aromatic hydrocarbon from liquid fuel, and the reformed gas fuel which is rich in hydrogen. Paraffin hydrocarbon gas, such as methane, ethane, and a propane, is contained in the reformed gas fuel out of hydrogen.
[0013] Vapor-liquid-separation equipment 8 has the function which separates the reforming liquid fuel of a high octane value which is rich in aromatic hydrocarbon, and the reformed gas fuel which is rich in hydrogen, and supplies a part of the reforming liquid fuel [at least] to an internal combustion engine 1, and supplies some reformed gas fuels [at least] to the gas combustion equation heater 13 of the reforming machine 5. Furthermore, vapor-liquid-separation equipment 8 also has the function which supplies some reformed gas fuels [at least] to an internal combustion engine 1. In the example, although vapor-liquid-separation equipment 8 has a vapor-liquid-separation function and fuel feeder ability, it may be made to perform fuel supply with another equipment.
[0014] The reforming machine 5 is filled up with the catalyst which promotes a cyclodehydrogenation reaction. As a catalyst for a cyclodehydrogenation reaction, crystalline aluminosilicate, for example like a zeolite and ZSM-5 zeolite which had MFI structure especially are suitable, and the thing which is chosen from a gallium, zinc, and platinum and which contain a kind at least is desirable preferably. Moreover, the temperature of a cyclodehydrogenation reaction is set as 400-700 degrees C.
[0015] Table 1 makes a catalyst proton mold ZSM-5 (H-ZSM -5), gallium qualification ZSM-5 (Ga-ZSM -5), and zinc qualification ZSM-5 (Zn-ZSM -5), respectively, and shows the reforming result of having performed the cyclodehydrogenation reaction, using n pentane as a fuel. The amount of a gallium and zinc was made into 2wt(s)% of catalyst weight. Reforming conditions were set to - with a weight space velocity (WHSV) of 2h 1 and reforming temperature of 550 degrees C, and ****** 0.1MPa.
[0016]
[Table 1]

触　媒	改質燃料の成分（ｗｔ％）		
	水　素	パラフィン系炭化水素ガス	芳香族炭化水素
Ｈ－ＺＳＭ－５	2.0	54.9	43.1
Ｇａ－ＺＳＭ－５	3.0	46.4	50.6
Ｚｎ－ＺＳＭ－５	3.6	44.8	51.6

[0017] If H-ZSM -5 is used as a catalyst, it is clearer than Table 1 that a cyclodehydrogenation reaction fully advances. When the catalyst embellished with a gallium or zinc is used, it turns out that the yield of aromatic hydrocarbon and hydrogen is increasing from the case where H-ZSM -5 is used.
[0018] In said structure, the closing motion valve 4 is open, and liquid fuel is supplied to the inlet port of the reforming machine 5 through a supply pipe 3 in the closing motion valve 14 in the state of close from the

liquid fuel tank 2. In this case, it is also possible by opening the closing motion valve 14 to supply an internal combustion engine, without reforming liquid fuel. The reforming fuel which consists of a reformed gas fuel which is rich in the reforming liquid fuel and hydrogen of a high octane value which are rich in aromatic hydrocarbon in the reforming machine 5 with the cyclodehydrogenation reaction of liquid fuel is generated. As for a reforming fuel, the closing motion valve 6 is supplied to vapor-liquid-separation equipment 8 through a supply pipe 7 in the state of open from the outlet of the reforming machine 5. In vapor-liquid-separation equipment 8, a reforming fuel is divided into reforming liquid fuel and a reformed gas fuel, and, as for reforming liquid fuel, the closing motion valve 9 is supplied to an internal combustion engine 1 through a supply pipe 10 in the state of open. On the other hand, the closing motion valve 11 is open, and, as for a reformed gas fuel, the closing motion valve 16 is supplied to the heating gas combustion equation heater 13 of the reforming machine 5 through a supply pipe 12 in the state of close. In this case, the closing motion valve 16 is able to supply some reformed gas fuels to an internal combustion engine 1 through a supply pipe 17 in the state of open. Moreover, it is also possible to use the heat of an internal combustion engine's 1 exhaust gas with the gas combustion equation heater 13 as a heat source for heating of the reforming machine 5.

[0019]

[Effect of the Invention] According to invention of claim 1 and three to 5 publication, by constituting as mentioned above, the liquid fuel of a high octane value which is rich in aromatic hydrocarbon can be obtained, and the car which might make it have made it an internal combustion engine's energy efficiency improve can be offered.

[0020] According to invention according to claim 2, the car which enabled it to stabilize the reforming reaction of a reforming machine can be offered.

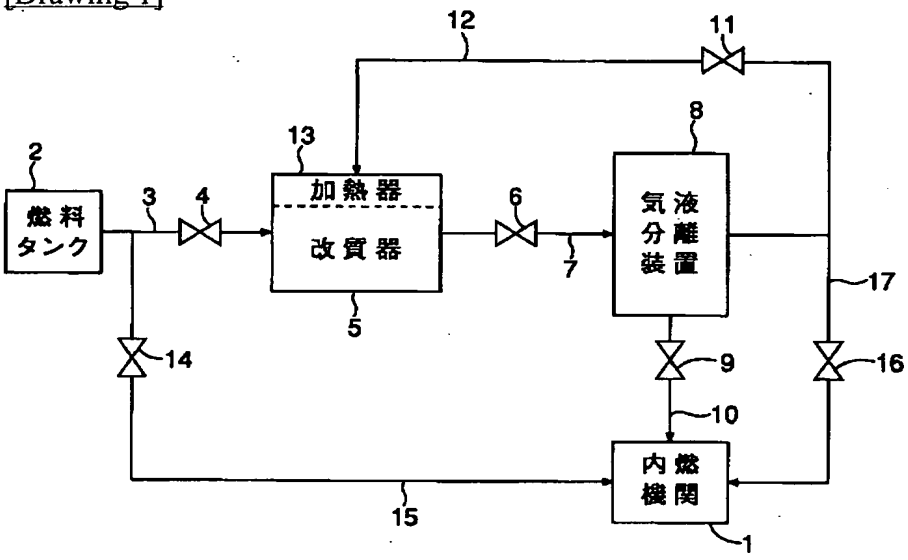
[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Translation done.]